

Foster, Sir George Thomas (1811-1891)

REPORT OF SUB-COMMITTEE OF
CONFERENCE OF
REPRESENTATIVES OF CANADIAN UNIVERSITIES
and
INDUSTRIAL INTERESTS
with

SIR GEO. E. FOSTER, K. C. M. G

Ottawa, May 25th, 1915.

Sir George E. Foster, K. C. M. G.,
Minister of Trade and Commerce,
Ottawa, Ont.

Sir:

The Sub-Committee of the Research Conference have the honor to report that the meeting was unanimous that a Commission of Industrial Research should be established and that it should represent all the interests of Canadian industries for the following reasons: -

- a- Countries that have developed their industries most successfully have done so by scientific research.
- b- Industry must be based on scientific knowledge.
- c- Closer association between the scientific institutions and the manufacturers in Canada is necessary.
- d- Best results are only secured by co-ordination of science and industry and such a Commission would be the intermediary between the Universities and the manufacturers.

- e- A department of this character would lead to the production of a number of experts who would be capable directors of works or professors of special processes.
- f- The systematic organization of science and industry would be a source of strength to the country; it would offer careers to our young men, and add enormously to the wealth and well being of the community.
- g- The proposed Commission would be immediate in its action as no time would be lost in building or organization seeing that the Universities are prepared to place their establishments, staffs and equipment at the disposal of a Commission of Research should same be inaugurated by the Government, while the Canadian Manufacturers' Association and the Canadian Section of the Society of Chemical Industry would support such a department to the best of their ability.

The Sub-Committee would, therefore, respectfully recommend that an impartial commission should be appointed on the lines (in a measure) of the Railway Commission, Conservation Commission and the Waterways Commission, and would suggest that the Commission should consist of (say) seven members representing as far as possible the Universities and manufacturing interests of Canada with power to initiate and to encourage research work of direct industrial value.

March 29th, 1915

Sir George F. Foster,

Ottawa, Ont.

Dear Sir George:

Mr. M. McLeod Clarke who graduates this year from the University with honours in the Department of English and History has informed me that he is making application to be appointed to a position as a Trade Commissioner. He has asked me to support his candidature for this position. This I can do with the utmost satisfaction. Mr. Clarke was one of the applicants this year for the Snodgrass Scholarship. We considered his case very thoroughly, and he had very many of the qualifications that Mr. Snodgrass required, though the competition seemed to the committee to be met more fully in the case of another candidate. Mr. Clarke is an excellent public speaker, as well as a good student. As a thoroughly well educated man of very wide experience and varied gifts I should think he is better than most of those who will apply for such a position.

I am,

Yours sincerely,

President.



C:

MINISTER'S OFFICE,

Ottawa, March 10th, 1915

Prof. R.W.Falconer,
University of Toronto,
Toronto, Ont.

Dear Dr. Falconer:-

I have yours of March 9th with reference to Mr. W.McLeod Clarke and am glad to have your appreciation of him, along the lines mentioned in your letter.

I have seen Mr. Clarke on one or two occasions and have had some conversation with him along the line of his desire, but nothing has yet developed of a direct nature.

Yours sincerely,

George S. B. Smith

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C O P Y

Ottawa, April 24th, 1915

Prof. Wm. Peterson, L.L.D., etc.,
McGill University,
Montreal, Que.

Dear Dr. Peterson:-

I am writing you with reference to several conversations that have passed between us regarding the plan for undertaking and carrying out of research work in connection with the Canadian Universities.

Whilst not committing the Government in any way to participation in what may be proposed, I think it would be beneficial if the representatives of these universities could arrange a meeting with myself and perhaps some other members of the Government in the near future with a view to a mutual understanding of what is proposed. If you are favourable to this, it might be well, perhaps, for you to communicate with Toronto and Queen's, and any other University that you think is in a position to co-operate with the work and arrange for representatives of these Universities to meet in Ottawa at their earliest convenience.

The Universities are coming up toward their close, and it would be advisable to have this matter arranged, if a conference is decided upon, before the staffs of the different universities are dispersed.

Kindly let me hear from you in respect of this.

Yours sincerely,
(sgd) George E. Foster.



MINISTER'S OFFICE,

Ottawa, April 24, 1915

R. A. Falconer, Esq., C.M.G., LL.D.,
President, University of Toronto,
Toronto, Ont.

Dear Dr. Falconer,-

I am sending to you copy of a letter which I have sent to Dr. Peterson of McGill University so that you may think the matter over and be ready to advise with me when you receive word from him.

I understand that in some way the Universities have communicated to each other their views in respect to the matter referred to.

Yours sincerely,

George E. Foster

COPY

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DEPARTMENT OF TRADE AND COMMERCE

MINISTER'S OFFICE

Ottawa, April 24th, 1915.

Prof. Wm. Peterson, M.D.,
McGill University,
Montreal, P.Q.

Dear Dr. Peterson,

I am writing you with reference to several conferences, that have taken place between us regarding the plan for undertaking and carrying out of research work in connection with the Canadian universities.

Without committing the Government in any way to participation in what may be proposed, I think it would be beneficial if the representatives of these universities could arrange a meeting with myself and perhaps some other members of the Government, in the near future, with a view to mutual understanding of what is proposed. If you are favorable to this, it might perhaps be well for you to communicate with Toronto and Queen's and any other University that you think is in a position to co-operate with the work and arrange for representatives of these universities to meet in Ottawa at their earliest convenience.

The universities are coming up toward their close, and it would be advisable to have this matter arranged, if a conference is decided upon, before the staffs of the different universities are dispersed.

Kindly let us hear from you in respect of this.

Yours very truly,

(Sgd). George E. Foster.

April 26th, 1915

Hon. Sir G. B. Foster, K.C.M.G.,
Minister of Trade and Commerce,
Ottawa.

Dear Sir George:

I have just received your letter together with the copy of one sent to Principal Peterson of McGill University. I shall be glad to arrange for a conference with Dr. Peterson and Dr. Gordon, or any other representatives, and will endeavour to arrange my time to suit what is most convenient for others, though I am afraid that ^{on} any day this week except Saturday it would be impossible for me to be in Ottawa.

Yours sincerely,

President.

27th April 1915.

The Hon. George E. Foster,
Dept. of Trade & Commerce,
Ottawa, Ont.

Dear Sir George Foster,

I beg to acknowledge receipt of your favour of the 24th in which you suggest a meeting between yourself and perhaps other members of the Government, and representatives of Canadian universities for the discussion of plans for undertaking and carrying out research work.

I am communicating with Toronto and Queen's on the lines of your suggestion, and venture to think that it would be unnecessary, in the first instance at least, to go further afield for those who would take part in what I understand from your letter will be, to begin with, only informal conversation.

Here, in McGill, I am getting into touch with Dr Ruttan for chemistry, Dr Barnes for physics and Dr Adams as Dean of the Faculty of Applied Science.

I think I mentioned to you in conversation that our Forest Products Laboratory, which owes a great deal to the Minister of the Interior and also to Mr Campbell of the Forestry Department, is to be opened at an early date, possibly on the morning of the 12th May when we have our annual convocation.

When you are in a position to fix a date I shall do my best to get together those who would be in the best position to ap-

Sir G.E.F.-2

preciate what you may have to put before us.

Meanwhile I am,

Yours very truly,

Principal.

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C.

MINISTERS' OFFICE.

Ottawa, May 11th, 1915

Prof. R.A. Falconer, L.L.D. etc.,
University of Toronto,
Toronto, Ont.

Dear Prof. Falconer:-

Dr. Peterson has sent me your note with reference to a convenient time for a meeting at Ottawa. He agrees that either the 24th or 25th would suit him, and I am therefore making the appointment for the 24th, and would be very glad if you could be present on that date, either in person, or through such representatives of your University as you may select.

Some mention was made in my correspondence with Dr. Peterson as to inviting Mr. Murray of the Canadian Manufacturers' Association to be present. I should very much like to have him present and if you see no objection I shall ask him if he can come down to Ottawa on that date.

Yours sincerely,

W. A. G. B. B. B.

May 12th, 1915

Sir George F. Foster, K.C.M.G.,

Ottawa.

Dear Sir George:

May 24th will suit me for the conference with you in Ottawa. I will take one or perhaps two members of the University with me.

It would also I think be well to have Mr. Murray of the Canadian Manufacturers Association present, and if you invite him to come it will fall in with my own views.

Yours sincerely,

President.

EXTRACT OF LETTER FROM REV. DR. GORDON.

"I think such a conference should lead to some helpful results. We have the three factors which we want to bring into closer relations -

1. The Government represented in the present case by the Department of Trade and Commerce.
2. The producers, manufacturers, farmers, foresters, miners, etc., who should have the benefit of the best scientific results and methods in their work.
3. The universities with their laboratories fitted for research work.

The Government might act as medium to secure for the producers the co-operation of the universities. A bureau in the Department of Trade and Commerce, or Agriculture, or both, might serve this purpose. It might distribute bulletins of information, and be open to receive from the manufacturers etc., questions and problems as to improved methods of production, and it might submit to the universities these problems for consideration.

Our own work at Queen's in regard to milk and cheese, to potash, to cobalt, etc., illustrates what can be done in our laboratories for the industrial interests, and such a bureau as I suggest might help to secure co-ordination and co-operation on the part of the University Laboratories.

The Government might enable us at compensating small cost, to add to our staff some whose special work would be research, and graduate students might also be secured for this purpose.

You are no doubt familiar with the work at the Mellon Institute at Pittsburg. A departmental bureau established by the Government, and the mining laboratories working in conjunction with it might accomplish for our manufacturers and other producers results as helpful as those of the Mellon Institute".

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MINISTER'S OFFICE,

Ottawa, June 2nd 1915

Dr. R. A. Falconer, President,
University of Toronto,
T o r o n t o. Ont.

Dear Sir,

I have to acknowledge receipt of your letter of the 1st with enclosed corrected copy of your remarks at the conference of university representatives, and will be glad to see that this is substituted in the record.

Yours faithfully,

Private Secretary.

June 1st., 1915

C. H. Payne, Esq.,

Sir George Foster's Office,

Ottawa.

Dear Sir:

I have read over the remarks which you have placed under my name in the precis of the Conference of Universities' representatives held in Sir George Foster's office on May 25th. I enclose a corrected copy.

Yours sincerely,

President.

PRECIS OF CONFERENCE
OF
REPRESENTATIVES OF CANADIAN UNIVERSITIES
with
SIR GEORGE E. FOSTER, K.C.M.G.

OTTAWA, May 25th, 1915

P R E C I S O F C O N F E R E N C E .
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At the invitation of Sir George Foster, the following representatives of the various universities of Canada and the Canadian Manufacturers' Association met in his office on Tuesday morning, May 25th 1915.

R. A. Falconer, President of the University of Toronto; J. C. McLe^{man}an, Professor of Physics, University of Toronto; W. L. Goodwin, Dean of the Faculty of Practical Science, Queen's University; W. H. Ellis, Dean of the Faculty of Applied Science, University of Toronto; F. B. Adams, Dean of the Faculty of Applied Science, McGill University; H. M. MacKay, Professor of Civil Engineering, McGill University, Dr. R. F. Rattan, Director of the Department of Chemistry, McGill University; H. T. Barnes Director of Physics, McGill University; T. H. Wardleworth, Canadian Manufacturers' Association, Dr. W. Peterson, Principal of McGill University; G. T. Chown, Canadian Manufacturers' Association and Queen's University and Frank Arnoldi, President of the Royal Canadian Institute.

Sir George Foster, expressing his sympathy with the objects had in view, briefly explained his desire in calling the conference. The Government had not taken the matter into consideration, but was in sympathy with the general object. As representatives of the various universities and the Canadian Manufacturers' Association, they might, he thought, be able to make some suggestions which could be considered in a practical way.

Dr. Peterson - The Government is to be congratulated on taking up the matter. Countries in which industries are comparatively undeveloped are coming
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to the realization that to be successful, industry must be based upon some scientific knowledge. In this country this belief will gradually bring together the scientific expert in the laboratory and the manufacturer. The Mellon Institute at Pittsburg had men available to do certain lines of investigating work for manufacturers. In Canada closer association between the manufacturers and research laboratories was needed, and also greater appreciation of the fact that industry and commerce, to be progressive, must rest on a sound basis of scientific research.

An impartial commission, no doubt, could be appointed. It should be done between the individual worker and the community.

Dr. Falconer - Several gentlemen in Toronto, who have been interested in the Canadian Manufacturers' Association and the Manufacturers' Institute, have been in conference with the University of Toronto, keeping in view the possibility of bringing the resources of the university in touch with the manufacturer.

Leaving aside the large necessary outlay for research and application of science to industry, which is inevitable ^{in the future}, there are in Canada, in the various universities, well-equipped laboratories, and thus ^{at once} a fair beginning could be made. What is needed is a commission of direction which will be able to choose the problems that are most likely to be of national interest, and to ask the universities best equipped to ^{deal with each problem according to the special appliances & resources of each} ~~make a start~~. Central direction is necessary.

A great part of the results may be scientific and may not be seen immediately, but ^{these results} ~~it~~ will be ^a store for the future. The Government might probably have to bring in certain experts to do a certain kind of work and in time

equip *laboratories and*
time set-up ~~certain~~ separate buildings, but these would be under the direction of the Government and the universities would co-operate. The relation of the individual manufacturer is the matter for consideration. The universities would first be concerned with setting themselves free to the best of their capacity under the direction of the commission.

Something in this line had been done some years ago by Dr. Ellis *in regard* with ~~reference~~ to clays. The investigation was taken up actively for two years with the Department of Mines at Ottawa *but the department was unwilling to cooperate with the University*.
Cooperate with the University

In reply to a query by Sir George Foster as to whether or not an attempt had been made for practical connection between the forces of the university and the large businesses of the country, Dr. Falconer replied that manufacturers had on occasion been allowed to use the university laboratories for cost, but without any definite plan.

Dr. Peterson - McGill's University's connection with the railways has resulted in much work of that kind in various tests.

Professor McLellan - The Commission should be a large one, representing all interests, such as the manufacturers, the scientific staffs of the universities and scientific societies, like the Royal Society and the Canadian Institute. It had been hinted that this was a sort of conservation work, and in that sense it might be considered as a branch of the activity of the Conservation Commission.

There would be two kinds of problems: First, those of great national interest, the results of which would be scattered broadcast; and, second, particular cases presented by manufacturers, where the commission would find the man to carry on the experiments, and the results would be handed over to the manufacturer.

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The men and the laboratories are available in the universities; and effort should be to form a scheme with a basis of permanency. As the scheme develops, the time will come when special buildings will be evolved and consequently heads of departments, but there will, of course, still be connection with the universities. Local institutions will be required since special problems arise in every province, such as, clays in Ontario, mining in North Ontario, railway investigations in McGill, scientific farming in the west etc., etc. At present university men only are available, but differentiation must ultimately be made and the government will have to procure its own men.

When the Canadian Institute gives lectures, has an extensive library, and issues much literature, and in this way has been an intermediary between the university and the manufacturer.

Dr. Ellis - In Germany the university graduate is responsible for Germany's progress in many scientific lines as he brought his academic training into the commercial use. The directors of the great industries are scientifically trained men, understand the point of view of the graduate, and can therefore assist him. These heads of departments select graduates, who have been trained by their own professors and colleagues, and thus the industries are carried on in Germany by men scientifically trained. The reason hitherto why we in the United States and Canada have derived less direct advantage from university graduates going into the works is that these industries are new and have not had time to bring up a class of owners, directors, managers etc., scientifically trained and in sympathy with scientific methods.

But this situation will relieve itself. A few years ago the Ontario Government sent representatives to the

to the meeting of the Clayworkers' Association in Ohio. There is a growing desire on the part of owners of industries not only to have men employed in the works who know something scientifically about the work, but to have their sons educated in some institution along the lines of their future work and so not lose sympathy with the business.

Mr. Chown presented a memorandum based upon the discussions of the Canadian Manufacturers' Association and Queen's University.

The Government would have to co-operate more generously than had been done; there must be full co-operation between the universities and the Government. An instance was given where, at the request of the Government, a man had been supplied to carry on investigation regarding cobalt, a small grant made for expenses, and one result alone was a discovery which justified the whole expenditure. Queen's University has done informally whatever it could do to place its laboratories at the disposal of manufacturers. Much work on behalf of the Canadian Locomotive Works has been done. Some eighteen years ago, when corundum was first discovered, problems as to the extents of the deposits, how to concentrate and make it valuable, were placed in the hands of members of the university staff and worked out in co-operation with the Ontario Department of Mines. A start should be made with the facilities available.

Dairy chemistry is another instance. The Ontario Department of Agriculture made a grant of \$600. per annum and one assistant professor has put out substantial results of research for the dairy industry. Everyone of these bulletins has led to an improvement. The advance will be rapid and sure if co-operation is had

had by means of a commission.

Dr. Ruttan - In discussing the project in Montreal the same decision was arrived at as that contained in the memorandum presented by Mr. Chown, that is, it is necessary to have a central influential body, which might be called a commission, upon which there would be placed individuals able to give a certain amount of time to the problems which would come before them. This central commission would be composed of two classes of individuals: First, those able to set the problems, and second, those able to point out the way to solve them.

The Universities throughout the country are able to supply the buildings and energy necessary for chemical research. In McGill there is already a consulting board. In the Department of Chemistry are given professors representing the five fields of chemistry. These would be able to consult and act as an advisory body for any problem presented. The work could be more economically carried on with the existing laboratories and their staffs. In that way we have already a part of the Mellon Institute, namely, the building and the staff.

The expense might be borne in part by the universities, and this should be continued along academic lines, as they could probably be the most accurate lines. When the time arrives and the student is ready to solve commercial problems, then the central committee could present these problems. With reference to special problems, the work could be carried out along the lines of the Mellon Institute, that is, placing an investigator in the laboratory, pay his expenses and the University getting back their share of the expense.

While McGill has not had intimate contact with
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the commercial bodies in research, many researches have gone on in the university laboratories in connection with explosives, pulp, paper, etc. The staff of the university is, of course, very busily engaged in teaching, but outside persons could be brought in to do that kind of work. Six men could be taken in at McGill, allowing each a reasonable amount of room. McGill is only too anxious to help chemical industries in Canada.

Mr. Wardleworth - The scheme meets with the approval of the Canadian Manufacturers' Association. The Mellon Institute has fifty-four rooms; McGill, Toronto and Queen's each supplying six rooms would mean eighteen rooms available, and the work could be distributed in that way. A Commission is the right idea as it would be immediate, and could begin to utilize the resources now at our disposal. It will be a long time before a permanent institution is evolved, but a start having been made, harmonious co-operation of the universities, government and manufacturers, will build up to great advantage.

Dr. Adams gave a brief description of certain investigations which had been carried on. The Dominion Department of Mines when investigating regarding coal, ultimately decided to put up a special building for this work. In the same way an effort had been made to discover a method whereby zinc could be distilled and a great industry started. The investigation was ultimately transferred to British Columbia. The pulp manufacturers had also carried on some work with reference to pulp and paper.

The question has been whether the universities should start and the Government complete. If so, that will ultimately mean that the Government will have permanent institutions. This would be a matter for the

Commission

Commission to decide. The Commission should carefully outline methods so as to avoid duplication and competition with the universities, and also how to use the universities in the best way.

Dr. Barnes pointed out that, as instanced by his experiments with ice problems, certain assistance was needed for which the universities could not rightly be called upon. A Commission was greatly needed because there are some aspects of the problem which appear to be more of a scientific nature than industrial people would believe. There would be difficulty in leading the Government to believe the importance of results which might be attained if followed up.

Professor MacKay - The engineering department of McGill is often asked to carry on investigations such as testing materials. As, however, there are commercial bureaus doing this kind of work, only those tests are taken on which require special facilities. These problems soon get beyond the capacity of the plant, and also while each one brings different benefits, there would be greater benefit if the results could be co-related. The commission would perform a useful function in co-relating the results of such work in the different universities.

Mr. Arnoldi - Did not wish to contend with anything which had been said. It has been one of the aims of the Royal Canadian Institute in its sixty-five years of existence to develop the field. A library of thirteen thousand volumes has been amassed, lectures have been given etc. For research it is not only necessary to have a laboratory and a professor, but there must be the bibliography of the subject. The work instanced by the speakers has had considerable success, but it is apparent that there has been the

want

want of a concentrating power to co-relate the results. The object of the bureau which the institute has adopted, is to bring the manufacturers and universities into closer contact. It is not a business operation, but is done in pursuance of its chartered duties. There is a great deal of literature available in the United States regarding the question of such a commission, in all of which it is urged that the commission is an impossibility and will not bring results which the community desire. While the bureau may not be a model of what is required, yet there is the fact that here is a body already formed for taking up this work. The Mellon Institute is not a government institution. The bureau is not endowed, but there are now under way two investigations endowed to be carried on, and it was felt that something more than university or government participation is required to get the best results. The bureau would be better able to appoint a competent body of governors than any commission that can be established.

In response to an enquiry by Sir George Foster as to whether or not the results of the work of the universities had been published, the information was elicited that in government reports, university publications and individual bulletins, these accounts were available.

Dr. Peterson - favored a small commission. It should be selected by an independent department such as the Department of Trade and Commerce.

Dr. Adams - as to what would come back to the Government, a railway official had offered proof, that as soon as his railway adopted a certain headlight, which had been worked out in the McGill laboratory, there would be a saving of one hundred thousand dollars per
year

year, more than had been put into it.

Sir George Foster -- Some points would need consideration with reference to the commission. No fanciful heads are wanted, but men who would be the best fitted to do the work. The Commission should be sufficiently numerous to include the main factors interested. Whether five or nine commissioners would be sufficient would have to be considered, but they should represent the vital interests.

Professor McLennan - It has been suggested that the establishment of an industrial museum would help. That, of course, would be a matter for the commission to decide, but the suggestion was made merely with a view to finding out whether it should be put into the foreground.

Sir George Foster - There has been considerable correspondence in the Department in regard to this matter, and it was unfortunate that Mr. Grigg, who was investigating along this line, was not present.

Mr. Chown - The unanimity of the views expressed is remarkable in view of the fact that there has been no opportunity for collaboration and discussion on the subject.

Sir George Foster - Was entirely in sympathy with beginning on the essentials and in the smallest compass, and then working up. All the elements have not been heard, and it is possible that the Government Departments which have been carrying on the work along research lines may wish to continue. These interests must be consulted. Sympathy with the general object, some knowledge of university life, a feeling that the universities in the past have kept themselves too much isolated

isolated, and that it would give vigor and popularity to the universities themselves if they could work in with industrial and business life of the country, and be looked upon as contributing in a very practical and important way to the general business of the country, these were the considerations which had led him to desire this conference. The scientific side of research work must, of course, be kept first in view, but the commercial results arising therefrom are of great use and appeal most to the people.

Professor Falconer - With reference to the financial side, the universities might make one contribution, and those who are getting benefit therefrom, the other, and these two branches might be co-operated with by government aid. It would not be advisable to eliminate the attempt to draw out from the business institutions and business men themselves their very generous co-operation in the financial way, because so much comes to them in the end. The Government can stifle general good by doing too much. The question was as to from whom the appeal to business interests should come.

Sir George Foster - The matter had hardly gone that far. It will no doubt be found to work out that the business interests will be best appealed to through the Canadian Manufacturers' Association, and other associations who are interesting themselves in this matter.

At the suggestion of Sir George Foster a representative committee comprising Professor McLennan, Dr. Rattan and Mr. Wordleworth, was named for the purpose of drafting a memorandum embodying the views of the conference based on the morning's discussion.

REPORT ON THE PLAN PUT FORWARD BY THE
ROYAL CANADIAN INSTITUTE IN A PAMPHLET
ENTITLED "BUREAU OF SCIENTIFIC AND
INDUSTRIAL RESEARCH AND SCHOOL OF SPECIFIC
INDUSTRIES OF THE ROYAL CANADIAN INSTITUTE".

February 8th, 1916.

REPORT ON THE PLAN PUT FORWARD BY THE ROYAL CANADIAN
INSTITUTE IN A PAMPHLET ENTITLED " BUREAU OF SCIENTIFIC
AND INDUSTRIAL RESEARCH AND SCHOOL OF SPECIFIC INDUSTRIES
OF THE ROYAL CANADIAN INSTITUTE."

At a meeting of members of the staff in Science and Applied Science of the University of Toronto called to consider the proposal of the Royal Canadian Institute with regard to the establishment of a Bureau of Industrial Research it was resolved:

That in the opinion of this meeting the proposal of the Royal Canadian Institute as set forth in its printed circular is not feasible for the following reasons.

The Faculty of Applied Science deal with the proposal as follows:

There are two methods by which universities or other public bodies may promote the application of Science to Industry, viz:-
(i) by the investigation of industrial problems of general interest to the State or to all engaged in some particular industry, and (ii) by the investigation of problems of immediate interest to some individual manufacturer, on the understanding that the results obtained will be his private property, or will in the first instance at least be available only to him, for his personal pecuniary advantage. The Royal Canadian Institute plan deals with investigations of the second class only; and contemplates the establishment of individual manufacturers of paid "fellowships", the holders of which (under competent direction) will work on problems of commercial interest to the individuals who found the fellowships.

This plan is stated in the pamphlet to be in "Imitation of the Mellon Institute of Pittsburgh". It differs, however, from the plan in operation at that Institution in two important particulars.

(a) According to the Royal Canadian Institute plan, negotiations with the manufacturer who provides the funds will be

carried out by an officer of the Royal Canadian Institute, while the responsibility for obtaining results satisfactory to the manufacturer will fall on officers of the Universities, i.e. on the professors in whose laboratories and under whose direction the investigation is to be carried out. Put briefly, promises are to be made by one body which it is left to the other to perform. There is no such divided responsibility in the Mellon Institute. Unless and until the Royal Canadian Institute has laboratories, staff and equipment of its own, the most it can do in this direction is to introduce the manufacturer to the proper university authority and leave the two to make their own arrangement.

(b) According to the Royal Canadian Institute pamphlet, any funds that may be collected by the Royal Canadian Institute for the purposes of their Bureau, over and above the amount stipulated for the salaries of fellows and the provision of material used by them, will not be handed over to the universities where the work is done to recoup them for "overhead" costs and for incidental expenses occasioned by the work done, or to enable them to increase their staffs or their laboratory facilities; on the contrary, such moneys will be retained by the Royal Canadian Institute, and will be expended by them "to provide for the salaries and outgoings necessary for organising and carrying on the work of the Bureau, to provide the necessary buildings and premises for housing the library", (at present housed free by this University) "the Bureau and its work, in which building provision shall be made for housing and carrying on the work of the Royal Canadian Institute not provided for in the Bureau", and "to provide an endowment or fund for the perpetuation of the Bureau and its work".

In other words, while the work is to be done in the universities, any fund that may be built up will be the property of an outside organisation. There is no such division of interests in the

Mellon Institute; work done there enhances the reputation of the institution and staff that carry out the work, and any funds that this reputation may attract are used to build up the staff and facilities of the institution where investigations are made.

To suppose that a serious investigation could be carried out by a young graduate at a small salary, independent of advice and assistance from those of more experience is absurd, and the more work of this kind that is undertaken, the larger will be the staff required. In the University of Pittsburgh of which the Mellon Institute is an integral part, the Department of Chemistry includes 14 professors, 13 assistant professors and 10 instructors; and the laboratory accommodation and facilities used for research alone are said to have cost over half a million dollars.

Undergraduate Students.

It might be thought that the investigation of the manufacturers' problems could be entrusted to senior undergraduate students in connection with the preparation of their theses for the degree and could in this way be undertaken without entailing any new expense on the laboratories. It must be remembered, however, that such students would not be in a position to devote all their time and attention to the problem supplied; only part of their laboratory hours is available for thesis work, and much of their attention would be taken up with the other subjects of their final examination.

Moreover, it is an essential feature of all paid work that he who pays expects definite results in a fixed time; so that if the results were not being obtained quickly enough by an undergraduate investigator, it would be almost necessary for some instructor to take the matter out of the student's hands, and reduce him to the position of a mere workman. Additional labour and anxiety would thus be thrown on the instructor, while the student would lose his opportunity of learning to carry on independent research, and with

it the main benefit to be derived from his final year in the University. The plan of avoiding expense by leaving the work to undergraduates must therefore be rejected.

As detailed later in this Report, a not inconsiderable amount of the kind of work contemplated by the Royal Canadian Institute has already been done and is now being done in the laboratories of this University. Any considerable extension of this work will involve increased expenditure, whether it be done under the Royal Canadian ^{Institute} plan or under any other plan, but it would be a most uneconomical use of public funds to spend them on purchasing land and erecting, heating and maintaining laboratories and supporting the clerical and scientific staff of a new institution.

In Canada very few of the industries have properly equipped laboratories of their own, and there are only two or three well supplied commercial consulting laboratories to which they may apply for temporary assistance. It is therefore natural that advice is commonly sought from visitors of this and other universities. Such advice and assistance is readily given whenever possible; for it is to the direct interest of the universities that those engaged in teaching applied science should keep in close touch with the realities of commercial life.

The Professor of Physics states that in regard to the proposal of the Royal Canadian Institute the policy that he has always followed since he became head of the laboratory should in his opinion apply, namely, to afford all properly accredited bodies and individuals whatever space and apparatus in the Physical Laboratory is in the opinion of the Director of the laboratory available for the purpose of the research such bodies or individuals wish to carry out.

The Professor of Biology states that the members of his Department would be glad to co-operate with the Royal Canadian Institute in the plan of Industrial Research if financial provision is made so that the scheme will be effective. At the present moment he thinks it is difficult enough to maintain the teaching programme, and that a good graduate student cannot be obtained at any moment a firm may see fit to grant us money, but only if the University has already developed a working plan of graduate appointments. Unless a special endowment or foundation is available, it is evident that the expense of maintaining the system will fall to the University.

The Associate Professor of Botany heartily approves co-operation with the Bureau of Industrial Research of the Canadian Institute, wherever, and whenever possible. Many industrial problems in mycology, zoology, wood-technology, smelter fume injuries, etc., are wholly or in part botanical, and it will be valuable to us to be brought as closely as possible into contact with the needs of the industrial world wherever they touch our science.

Notwithstanding however the objections that have been pointed out with regard to the proposals of the Royal Canadian Institute the Science staff of the University is of opinion that the University should welcome the co-operation of the Royal Canadian Institute which might take these directions:

- (a) Interesting manufacturers in the application of science to industry.
- (b) Co-operating with the University in the endeavour to secure greater support from the Dominion and Provincial Governments in this regard.
- (c) Securing scholarships to be called the Royal Canadian Institute Research Scholarships to be held in the University under the direction of the Heads of University Laboratories.

The Science staff also desire to draw the attention of the Governors to the fact that a great deal of ~~the~~ ^{of the kind} work described in the proposals of the Royal Canadian Institute has been done in the scientific laboratories and especially in the Faculty of Applied Science of the University of Toronto.

The Faculty of Applied Science make the following report as to the application of Science to Industry.

THE APPLICATION OF SCIENCE TO PROBLEMS OF INTEREST
TO THE STATE OR TO A WHOLE INDUSTRY.

Such, for instance, are the exhaustive study of the mechanical properties of steel and the alloys, carried out by the German government at Gross-Lichterfelds; the elaborate investigation of the problems of tanning and leather manufacture carried out by the Leather Sellers Guild in London; and the important experimental work on the "cracking" of petroleum and the extraction of radium now in progress under the Bureau of Mines of the United States.

Work of this class done in the laboratories here is necessarily on a more modest scale; an idea of its amount and nature may be gained from the following partial list of investigations carried out in the laboratories of this Faculty during the last few years.

LIST NO. 1.

The experimental work involved in the investigations enumerated above was carried out by members of the staff, usually with the co-operation of students or junior assistants. Many minor investigations have been completed by graduate students or by undergraduates in connection with the preparation of their theses for the degree. The problems are often suggested by the student's vacation experience in the factory or the mine and a successful result, when

obtained, usually leads to permanent employment. The work, however, is not paid for, and the results may be published. A few examples may be quoted:-

Rubber: A student who had spent his vacation in a rubber works on returning to the laboratory studied the methods of analysis and improved on one of them. He obtained a position with the company. This case is typical of half a dozen others.

Wood distillation: Four students on different occasions made a chemical study of certain by-products of the manufacture of wood alcohol, which at that time were regarded as waste products, and for the most part burned. Two of them obtained positions with a wood distilling company.

Spirits: A student examined the fusel oil from a large distillery and isolated a number of its constituents. The results were published in the Journal of Industrial and Engineering Chemistry. This man is now the Technical Director of the distillery.

Coal Gas By-products:
----- A student who in his fourth year tried out some proposed new methods for extracting ferrocyanides from gas-house waste, obtained results of commercial importance, and is now Chief Chemist of a large manufacturing company.

This list could be extended to include an account of similar work on sugar, starch, sulphate of ammonia, synthetic drugs (vanillin, antipyrine, phenol, picric acid, etc.) paper pulp, coal gas, synthetic ammonia, formaldehyde, oils and fats, etc. etc. but those detailed above are sufficient to show the nature of the problems attacked. In some cases results were obtained, in others not.

Shortly before the war broke out the Engineering Alumni Association of this University founded two scholarships for industrial research. One of these in the Department of Electrical Engineering after two years experimental research, yielded results

of first rate importance regarding the operation of the Hydro-Electric 110,000 volt transmission lines; and as a result, after consultation with the Department of Electrical Engineering, the investigator was appointed engineer-in-charge of the Laboratories of the Hydro-Electric Power Commission of Ontario. The other, which dealt with the recovery of resinous products from wood, was less successful. Financial conditions arising out of the war have led to the temporary suspension of these fellowships.

Suggestions for the extension of this work.

Attention might be drawn to the communication of the Professor of Physics which says that the University first of all should take as wide a survey as possible of what are the needs of our country, propose a scheme to meet them and this will shew how best our Universities can help in the movement.

If our University should take too narrow a view of the situation it may be that their proposals may not receive greater consideration than those brought forward by the Royal Canadian Institute.

The Faculty of Applied Science report as follows:

Any considerable extension of this work will necessitate provision for relieving members of the teaching staff of some of their present duties, and in some departments will require the provision of additional laboratory facilities. In other words, it will involve expense. Some of this additional expense might very properly be shared by the Dominion or Provincial Government.

(A) Co-operation with the Dominion Government.

The Dominion Government has already supplied funds for a study of the coals of Canada at McGill University, for the development of commercial uses of cobalt at Queen's and for a study of the clays of

Canada here. By co-operation in this way the Government secures at minimum cost the use of laboratory facilities and apparatus and the assistance of a trained staff; in particular they secure the opportunity of attracting the attention of students of Applied Science to problems of the greatest importance to the country. In the case of the ceramics laboratory, until recently established in Toronto, there was the additional advantage that this city is the head of the clay industries of the Dominion; the decision to remove the laboratory to Ottawa is for every reason much to be regretted.

There is at present in Canada no institution corresponding to the German "Reichsanstalt", or to the "Bureau of Standards" of the United States Government. The establishment of such institutions has been found necessary by all the large industrial countries of the world, but in Canada questions of expense and situation, the difficulty of obtaining a suitable staff, and other reasons have caused delay. In the opinion of this Council, better results would be obtained by establishing Branches of such a Dominion Bureau at the University of Toronto and at McGill University than by founding an isolated Institute at Ottawa. The equipment of the universities would then become immediately available, an economical beginning could be made, and as the importance of the results became recognized the scale of the undertaking and the expenditure on it could be increased. Apart from the saving in money, this plan has the advantage over the establishment of an isolated institution, that it would offer guidance and inspiration to the young men now being trained in Science, by whom, after all, the practical applications of science to the individual industries of the country must be made.

The establishment of such a Branch here seems the best way in which the Dominion Government could co-operate with this University in

promoting the application of Science to Canadian Industry.

In view of the interest in Industrial Research displayed by the Minister of Trade and Commerce an attempt might be made to procure funds for this purpose from the Dominion Government. Suggestions for the formation of a Royal Commission to carry on work of this kind in co-operation with the universities have already been laid before him, and these representations might be renewed.

(B) Co-operation with the Bureaus of the Government of

Ontario.

An attempt might be made to establish closer relations with the Provincial Bureau of Health (the Director of which is a Professor in this Faculty), with the Provincial Bureau of Mines, and with the newly established laboratories of the Hydro-Electric Commission.

(C) The provision of Research Assistants or Fellows might be considered by the University, the holders of which, under the direction of members of the staff, could carry to completion industrial researches already begun here, or others which could not be undertaken for lack of such assistance. This suggestion does not imply the immediate establishment of a large number of such assistantships, or that such as might be established should be allotted according to any symmetrical scheme. A plan of this kind has been found to work well in certain of the universities of the United States; at the University of Illinois, for instance, where an "Engineering Experiment Station" conducted by the University has been in successful operation since 1904, and has already published 80 Bulletins on "problems of importance to professional engineers and to manufacturing, railway, mining, constructional and industrial interests of the State."

THE APPLICATION OF SCIENCE TO PROBLEMS OF INTEREST TO
INDIVIDUAL MANUFACTURERS OR CORPORATIONS ENGAGED IN INDUSTRIAL
PURSUITS.

Owing to the absence of large suitable equipped commercial laboratories in this country which will probably not be provided until the manufacturers have been educated up to the necessity for them, it is obviously desirable that members of the Faculty of Applied Science, with the equipment at their disposal, should help in the application of science to the problems of the individual manufacturer - using that term in its widest sense. It is also clear that the manufacturer so helped ought to make some payment for the assistance received; more particularly because, as a usual thing, he objects to the publication of the results obtained, for fear that details of his business might thus become available to competitors.

In so far as they undertake work of this nature, the members of the Faculty constitute a body of skilled advisers whose assistance is available at low cost to the industries of the country.

The members of the Faculty of Applied Science desire herewith to submit the following incomplete list of problems that they have undertaken, which though it is partial will give an idea of the nature and extent of the work performed; because of the special interest attached to them, investigations arising out of the situation created by the war are placed at the head of the list.

List No. 2

Suggestions for the extension of this work.

It should be clearly understood from the outset, that if work of this class is to be materially extended, additional funds will be needed.

The Royal Canadian Institute Plan.

As already pointed out, the plan put forward by the Royal Canadian Institute differs from that in operation at the Mellon Institute, in that the Mellon Institute is an integral part of the University of Pittsburgh, while the Royal Canadian Institute Bureau is to be an independent body, looking to the universities for assistance in its work. The inconveniences arising out of this arrangement have been discussed already: in the present connection it is only necessary to point out that although under this plan the manufacturer would pay the salary of the investigator and provide him with material, the University would be expected to provide free of cost laboratory accommodation and facilities, as well as the time of its senior professors.

Memorandum for consideration at a Conference on Industrial
Research to be held in Ottawa May 25th, 1915.

1. It is desirable to appoint a Commission on Industrial Research.
2. The Commission to consist of nine members and a paid Secretary.

The Members to be (a) Minister of Trade and Commerce (Chairman).
(b) Commissioner of Commerce (Vice-Chairman).
(c) Three representatives of the Universities.
(d) Two representatives of the Manufacturers' Association.
One representative of the Society of Chemical Industry.

3. The Commission to supervise three different forms of Research,--

- (a) University Research.
- (b) Research for individual manufacturers.
- (c) Scientific Research.

University Research.

A Commission will arrange with the different Universities to undertake research in subjects which will be of importance to the whole country, -- as the Paper and Wood Industry at McGill, Metallurgical Problems at Queen's and Dye Stuffs and Cements at Toronto, and other Universities as they are prepared to undertake the work. Representations to be made by the Universities to the Commission regarding the equipment and staff available and the Commission would pass upon the recommendation and provide the necessary funds.

Research for Individual Manufacturers.

The work would be somewhat similar to that of the Mellon Institute, where individual manufacturers having problems establish scholarships for one three or five years for the investigation of these problems, and provide the funds for the payment of salaries and necessary apparatus. The results of the investigation to become the personal property of the manufacturer establishing the Scholarship.

Scientific Research.

The researches under this head while not so closely associated with industry might have very important commercial or practical applications. It would be desirable to establish a fund like the Royal Society of London, or the Rumford Fund of the American Academy of Arts and Sciences under which any Professor in any of the Universities might submit the problem to be investigated to the Commission and receive a grant there for to purchase equipment and apparatus, the results to be published for the benefit of the country as a whole.

4. The work of a bureau of standards like the U.S. Bureau of Standards or the German Reichsanstalt, while not so definitely under the charge of a Commission on Industrial Research, might receive assistance from the Commission, and until such times as we have a bureau of standards the different problems that arise regarding the Standardization of measuring instruments might be taken up by any of the Universities with the necessary equipment under the supervision of the Commission.

5. It would be necessary to correlate the work of the Commission with the work already in process under the supervision of the various Departments of the Dominion Government.

Memorandum in regard to remuneration of Staff.
.....

- (1) Some eight years ago the Governors, recognizing the inadequacy of the salaries, increased the rate of remuneration. The expense of living has, according to the Government reports, increased 51% in the last twelve years. It is evident that an advance in salaries is no less necessary now than it was eight years ago.
- (2) At the time of the re-adjustment of salaries, the Governors undertook to continue the payment for Examinations, - after having given this point special consideration. Notwithstanding, this source of income has been cut off. If a change in this regard be granted to have been expedient, it was yet an extraordinary thing that it should have been brought about at the expense of an already ill-paid staff, - even if the amount involved were small. As a fact \$12000 or \$13000 per annum have been saved for the University; and, as a fact, a deduction of \$100, or \$50, or even \$25 from the income of ~~an~~ individual members of the Staff, is not, in their present financial position, a matter of insignificance.
- (3) In 1910 the Retirement Fund scheme was practically brought to an end; and the Governors informed the Staff that the Carnegie Fund was to take its place. Since that date decidedly unsatisfactory aspects of that Fund have disclosed themselves. To the representations of the Staff on this matter, no answer has been returned by the Governors.
- (4) Although, during the last quarter of a century, there has been a remarkable increase in the wealth of the Province, and a very great improvement in the buildings, equipment, etc., of the University, there has been a progressive deterioration in the financial condition of the Staff. The financial condition of the University has been always urged as preventing the adequate payment of the teaching body;

notwithstanding, money has been found for building, for equipment, for new faculties, for extension of the Staff, and for other purposes--whenever the demand seemed specially urgent.

- (5) Hence the Staff seemed to be forced to the conclusion that the authorities have not clearly realized the hardships involved in the conditions already indicated,-- the continual worry and distractions necessitated by unremitting attention to economy, even in the smallest matters; the hampering of the work of the teachers, and of their relations with the students through the lack of any margin of income beyond what is required for immediate needs; the expenditure of time and energy on supplementing their incomes from sources outside their regular academic duties.

The authorities are probably wholly unaware of the extent to which the salaries are augmented by private sources of income, and by outside work.

- (6) There exists a general tendency in the conduct of Universities, on this continent at least, to overlook the difficulty of getting, and the need of retaining a really effective teaching Staff; to disregard the inevitable impairment of efficiency through a wide-spread feeling on the part of the Staff that their efforts are neither fully appreciated nor adequately remunerated; to consider the excellence of a University as mainly determined by its buildings, equipment, size, variety of activities; and, while admitting that successful work by the Staff is the real essence of a University, to take it for granted that this is a thing easily attainable.